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AXION ELECTRODYNAMICS AND DARK MATTER FINGERPRINTS IN THE TERRESTRIAL MAGNETIC AND ELECTRIC FIELDS

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We consider mathematical aspects of axion electrodynamics in application to the problem of evolution of geomagnetic and terrestrial electric fields, which are coupled by relic axions born in the early Universe and (hypothetically) forming now the cold dark matter. We find axionic analogs of the Debye potentials, well known in the standard Faraday–Maxwell electrodynamics, and discuss exact solutions to the equations of axion electrodynamics describing the state of axionically coupled electric and magnetic fields in a spherical resonator Earth–Ionosphere. We focus on the properties of the specific electric and magnetic oscillations, which appeared as a result of the axion-photon coupling in the dark matter environment. We indicate such electric and magnetic field configurations as longitudinal electro-magnetic clusters.

Keywords: dark matter, axion-photon coupling, geomagnetism.

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1. Introduction

1.1. On the physical aspects of the problem of the axion-photon coupling

The term *dark matter axions*, which came into general use during the last decade, reflects a synthesis of two trends based on ideas of modern astrophysics and cosmology on the one hand, and of high-energy particle physics on the other hand. Dark matter, which neither emits nor scatters electromagnetic radiation, is considered to be one of the main cosmic substrates accumulating about 23% of the Universe energy. The mass density distribution of the dark matter is now well studied due to observations and theoretical modeling (see, e.g. [1–4] for details, review and references). The origin of dark matter is not yet established, but there are several hypotheses about its nature. The most attractive is the hypothesis that